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XVII.

A NEW FORM OF POLARIMETER.

BY EDWARD C. PICKERING.

Presented May 26, 1885.

Two instruments have been proposed for measuring the relative intensity of the components of a ray of polarized light. First, the Arago polarimeter, in which a number of glass plates are placed in front of a Savart polariscope, and may be inclined at any desired angle. Bands are produced by the Savart plate, which are made to disappear by inclining the plates so as to neutralize the polarization of the beam. The inclination of the plates is a measure of the intensity of the polarization. Secondly, a polarimeter was devised by the writer,* in which the light is admitted through a rectangular aperture, two juxtaposed images of which are formed by a double-image prism. If the light is polarized, the two rectangles will be of unequal brightness. Interposing a Nicol prism, the two images may always be rendered equal by rotating the Nicol. The intensity of the polarization is measured by the cosine of the angle of rotation. The principal objection to the Arago polarimeter is, that the law connecting the inclination of the plates and the amount of polarization is extremely complex, and is best determined experimentally in each case. This instrument is also ill adapted to measure a ray which is almost perfectly polarized, but when the polarization is slight, the well-known sensitiveness of the Savart bands renders the accidental errors small. The other form of polarimeter is open to the objection that it is not very sensitive when the polarization is slight. On the other hand, the amount of polarization is directly connected with the angle of rotation of the prism by a simple formula, and when a ray is strongly polarized it gives excellent results.

The advantages of both instruments appear to be combined in the following modification of the second instrument. The greater sensi-

* Proc. Amer. Acad., IX. 1.

tiveness of the Arago polarimeter seems to be due to the fact, that, instead of comparing the brightness of the field on two sides of the line separating them, the comparison may be made on both sides of each band, or throughout nearly the whole field. Accordingly, the rectangular aperture was replaced by a series of metallic bars separated by intervals exactly equal to their width. The double-image prism is then placed at such a distance that the separation of the images shall equal the width of the bars, so that the two images of the intervals shall be exactly in contact. If this condition is fulfilled, the bands will disappear, and the field will be perfectly uniform when the Nicol is turned so that the two images have equal intensity. A slight motion of the Nicol will render the bands alternately light and dark, and the exact point of disappearance may be determined with much precision. The sensitiveness appears to be even greater than that of the Savart plate, since the change in brightness is abrupt at the edges of the band, instead of varying continuously from the centre of the band to the centre of the interspace. The bands were made by cementing a piece of tin-foil to a plate of glass, ruling a series of parallel lines upon it, and removing the foil from the space between the second and third, and the fourth and fifth lines, &c. It was necessary that these intervals should be made less than the interval between the first and second, and the third and fourth lines, &c., by the width of the line cut in the foil; otherwise the bands would be narrower than the interspaces by this amount. The bands might also be sawed out of a plate of brass, and finished with a file. Since the separation of the images produced by Iceland spar varies with the angular direction of the ray traversing it, the bands will not disappear in all parts of the field at once. This, however, is rather an advantage, since the eye is extremely sensitive to a certain phase, in which the bands reappear equally in the two sides of the field. A pointer serves to guide the eye to the centre of the field. Should it be desirable to employ a large field, the rays may be rendered parallel by a convex lens at a distance from the eye equal to its focal distance. There are some advantages in substituting a simple plate of Iceland spar for the double-image prism. The rays compared then come in the same direction, instead of being inclined by an angle equal to that of the images of the prism. The two images do not lie in the same plane. This may be remedied by inclining the bars so that the right-hand edges shall always be in front or behind the left-hand edges. If, however, the bands are narrow, and are placed at the distance of distinct vision, this error is unimportant, and the bands may be made to disappear almost entirely.

TABLE I. — *Continued.*

2 v	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
o										
15	99.1	99.1	99.1	99.1	99.1	99.1	99.1	99.1	99.0	99.0
16	99.0	99.0	99.0	99.0	99.0	99.0	99.0	99.0	98.9	98.9
17	98.9	98.9	98.9	98.9	98.8	98.8	98.8	98.8	98.8	98.8
18	98.8	98.8	98.7	98.7	98.7	98.7	98.7	98.7	98.7	98.6
19	98.6	98.6	98.6	98.6	98.6	98.6	98.5	98.5	98.5	98.5
20	98.5	98.5	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.3
21	98.3	98.3	98.3	98.3	98.3	98.2	98.2	98.2	98.2	98.2
22	98.2	98.1	98.1	98.1	98.1	98.1	98.1	98.0	98.0	98.0
23	98.0	98.0	98.0	97.9	97.9	97.9	97.9	97.9	97.8	97.8
24	97.8	97.8	97.8	97.8	97.7	97.7	97.7	97.7	97.7	97.6
25	97.6	97.6	97.6	97.6	97.6	97.5	97.5	97.5	97.5	97.5
26	97.4	97.4	97.4	97.4	97.4	97.3	97.3	97.3	97.3	97.3
27	97.2	97.2	97.2	97.2	97.2	97.1	97.1	97.1	97.1	97.0
28	97.0	97.0	97.0	97.0	96.9	96.9	96.9	96.9	96.9	96.8
29	96.8	96.8	96.8	96.7	96.7	96.7	96.7	96.7	96.6	96.6
30	96.6	96.6	96.5	96.5	96.5	96.5	96.5	96.4	96.4	96.4
31	96.4	96.3	96.3	96.3	96.3	96.2	96.2	96.2	96.2	96.2
32	96.1	96.1	96.1	96.1	96.0	96.0	96.0	96.0	95.9	95.9
33	95.9	95.9	95.8	95.8	95.8	95.8	95.7	95.7	95.7	95.7
34	95.6	95.6	95.6	95.6	95.5	95.5	95.5	95.4	95.4	95.4
35	95.4	95.3	95.3	95.3	95.3	95.2	95.2	95.2	95.2	95.1
36	95.1	95.1	95.1	95.0	95.0	95.0	94.9	94.9	94.9	94.9
37	94.8	94.8	94.8	94.8	94.7	94.7	94.7	94.6	94.6	94.6
38	94.6	94.5	94.5	94.5	94.4	94.4	94.4	94.4	94.3	94.3
39	94.3	94.2	94.2	94.2	94.2	94.1	94.1	94.1	94.0	94.0
40	94.0	93.9	93.9	93.9	93.8	93.8	93.8	93.8	93.7	93.7
41	93.7	93.6	93.6	93.6	93.5	93.5	93.5	93.4	93.4	93.4
42	93.4	93.3	93.3	93.3	93.2	93.2	93.2	93.1	93.1	93.1
43	93.0	93.0	93.0	92.9	92.9	92.9	92.8	92.8	92.8	92.8
44	92.7	92.7	92.7	92.6	92.6	92.6	92.5	92.5	92.5	92.4
45	92.4	92.4	92.3	92.3	92.3	92.2	92.2	92.2	92.1	92.1
46	92.0	92.0	92.0	91.9	91.9	91.9	91.8	91.8	91.8	91.7
47	91.7	91.7	91.6	91.6	91.6	91.5	91.5	91.5	91.4	91.4
48	91.4	91.3	91.3	91.2	91.2	91.2	91.1	91.1	91.1	91.0
49	91.0	91.0	90.9	90.9	90.8	90.8	90.8	90.7	90.7	90.7
50	90.6	90.6	90.6	90.5	90.5	90.4	90.4	90.4	90.3	90.3
51	90.3	90.2	90.2	90.1	90.1	90.1	90.0	90.0	90.0	89.9
52	89.9	89.8	89.8	89.8	89.7	89.7	89.6	89.6	89.6	89.5
53	89.5	89.4	89.4	89.4	89.3	89.3	89.3	89.2	89.2	89.1
54	89.1	89.1	89.0	89.0	88.9	88.9	88.9	88.8	88.8	88.7
55	88.7	88.7	88.6	88.6	88.5	88.5	88.5	88.4	88.4	88.3
56	88.3	88.2	88.2	88.2	88.1	88.1	88.0	88.0	88.0	87.9
57	87.9	87.8	87.8	87.8	87.7	87.7	87.6	87.6	87.5	87.5
58	87.5	87.4	87.4	87.3	87.3	87.2	87.2	87.2	87.1	87.1
59	87.0	87.0	87.0	86.9	86.9	86.8	86.8	86.7	86.7	86.6
60	86.6	86.6	86.5	86.5	86.4	86.4	86.3	86.3	86.2	86.2
61	86.2	86.1	86.1	86.0	86.0	85.9	85.9	85.9	85.8	85.8
62	85.7	85.7	85.6	85.6	85.5	85.5	85.4	85.4	85.4	85.3
63	85.3	85.2	85.2	85.1	85.1	85.0	85.0	84.9	84.9	84.8
64	84.8	84.8	84.7	84.7	84.6	84.6	84.5	84.5	84.4	84.4
65	84.3	84.3	84.2	84.2	84.2	84.1	84.1	84.0	84.0	83.9
66	83.9	83.8	83.8	83.7	83.7	83.6	83.6	83.5	83.5	83.4
67	83.4	83.3	83.3	83.2	83.2	83.1	83.1	83.0	83.0	83.0
68	82.9	82.9	82.8	82.8	82.7	82.7	82.6	82.6	82.5	82.5
69	82.4	82.4	82.3	82.3	82.2	82.2	82.1	82.1	82.0	82.0

TABLE I. — *Continued.*

2 v	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
70	81.9	81.9	81.8	81.8	81.7	81.7	81.6	81.6	81.5	81.5
71	81.4	81.4	81.3	81.3	81.2	81.2	81.1	81.1	81.0	81.0
72	80.9	80.9	80.8	80.7	80.7	80.6	80.6	80.5	80.5	80.4
73	80.4	80.3	80.3	80.2	80.2	80.1	80.1	80.0	80.0	79.9
74	79.9	79.8	79.8	79.7	79.6	79.6	79.5	79.5	79.4	79.4
75	79.3	79.3	79.2	79.2	79.1	79.1	79.0	79.0	78.9	78.9
76	78.8	78.7	78.7	78.6	78.6	78.5	78.5	78.4	78.4	78.3
77	78.3	78.2	78.2	78.1	78.0	78.0	77.9	77.9	77.8	77.8
78	77.7	77.7	77.6	77.5	77.5	77.4	77.4	77.3	77.3	77.2
79	77.2	77.1	77.0	77.0	76.9	76.9	76.8	76.8	76.7	76.7
80	76.6	76.5	76.5	76.4	76.4	76.3	76.3	76.2	76.2	76.1
81	76.0	76.0	75.9	75.9	75.8	75.8	75.7	75.6	75.6	75.5
82	75.5	75.4	75.4	75.3	75.2	75.2	75.1	75.1	75.0	75.0
83	74.9	74.8	74.8	74.7	74.7	74.6	74.6	74.5	74.4	74.4
84	74.3	74.3	74.2	74.1	74.1	74.0	74.0	73.9	73.8	73.8
85	73.7	73.7	73.6	73.6	73.5	73.4	73.4	73.3	73.2	73.2
86	73.1	73.1	73.0	73.0	72.9	72.8	72.8	72.7	72.7	72.6
87	72.5	72.5	72.4	72.4	72.3	72.2	72.2	72.1	72.1	72.0
88	71.9	71.9	71.8	71.8	71.7	71.6	71.6	71.5	71.4	71.4
89	71.3	71.3	71.2	71.1	71.1	71.0	71.0	70.9	70.8	70.8
90	70.7	70.6	70.6	70.5	70.5	70.4	70.3	70.3	70.2	70.2
91	70.1	70.0	70.0	69.9	69.8	69.8	69.7	69.7	69.6	69.5
92	69.5	69.4	69.3	69.3	69.2	69.1	69.1	69.0	69.0	68.9
93	68.8	68.8	68.7	68.6	68.6	68.5	68.4	68.4	68.3	68.3
94	68.2	68.1	68.1	68.0	67.9	67.9	67.8	67.8	67.7	67.6
95	67.6	67.5	67.4	67.4	67.3	67.2	67.2	67.1	67.0	67.0
96	66.9	66.8	66.8	66.7	66.6	66.6	66.5	66.5	66.4	66.3
97	66.3	66.2	66.1	66.1	66.0	65.9	65.9	65.8	65.7	65.7
98	65.6	65.5	65.5	65.4	65.3	65.3	65.2	65.1	65.1	65.0
99	64.9	64.9	64.8	64.7	64.7	64.6	64.6	64.5	64.4	64.3
100	64.3	64.2	64.1	64.1	64.0	63.9	63.9	63.8	63.7	63.7
101	63.6	63.5	63.5	63.4	63.3	63.3	63.2	63.1	63.1	63.0
102	62.9	62.9	62.8	62.7	62.7	62.6	62.5	62.5	62.4	62.3
103	62.2	62.2	62.1	62.0	62.0	61.9	61.8	61.8	61.7	61.6
104	61.6	61.5	61.4	61.4	61.3	61.2	61.2	61.1	61.0	60.9
105	60.9	60.8	60.7	60.7	60.6	60.5	60.5	60.4	60.3	60.2
106	60.2	60.1	60.0	60.0	59.9	59.8	59.8	59.7	59.6	59.6
107	59.5	59.4	59.3	59.3	59.2	59.1	59.1	59.0	58.9	58.8
108	58.8	58.7	58.6	58.6	58.5	58.4	58.4	58.3	58.2	58.1
109	58.1	58.0	57.9	57.9	57.8	57.7	57.7	57.6	57.5	57.4
110	57.4	57.3	57.2	57.1	57.1	57.0	56.9	56.9	56.8	56.7
111	56.6	56.6	56.5	56.4	56.4	56.3	56.2	56.1	56.1	56.0
112	55.9	55.8	55.8	55.7	55.6	55.6	55.5	55.4	55.3	55.3
113	55.2	55.1	55.0	55.0	54.9	54.8	54.8	54.7	54.6	54.5
114	54.5	54.4	54.3	54.2	54.2	54.1	54.0	54.0	53.9	53.8
115	53.7	53.7	53.6	53.5	53.4	53.4	53.3	53.2	53.2	53.1
116	53.0	52.9	52.8	52.8	52.7	52.6	52.6	52.5	52.4	52.3
117	52.2	52.2	52.1	52.0	52.0	51.9	51.8	51.7	51.6	51.6
118	51.5	51.4	51.4	51.3	51.2	51.1	51.0	51.0	50.9	50.8
119	50.8	50.7	50.6	50.5	50.4	50.4	50.3	50.2	50.2	50.1
120	50.0	49.9	49.8	49.8	49.7	49.6	49.5	49.5	49.4	49.3
121	49.2	49.2	49.1	49.0	48.9	48.9	48.8	48.7	48.6	48.6
122	48.5	48.4	48.3	48.2	48.2	48.1	48.0	47.9	47.9	47.8
123	47.7	47.6	47.6	47.5	47.4	47.3	47.2	47.2	47.1	47.0
124	47.0	46.9	46.8	46.7	46.6	46.6	46.5	46.4	46.3	46.2

TABLE I.—*Continued.*

2 v	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
125	46.2	46.1	46.0	45.9	45.9	45.8	45.7	45.6	45.6	45.5
126	45.4	45.3	45.2	45.2	45.1	45.0	44.9	44.9	44.8	44.7
127	44.6	44.5	44.5	44.4	44.3	44.2	44.2	44.1	44.0	43.9
128	43.8	43.8	43.7	43.6	43.5	43.4	43.4	43.3	43.2	43.1
129	43.0	43.0	42.9	42.8	42.7	42.7	42.6	42.5	42.4	42.3
130	42.3	42.2	42.1	42.0	41.9	41.9	41.8	41.7	41.6	41.6
131	41.5	41.4	41.3	41.2	41.2	41.1	41.0	40.9	40.8	40.8
132	40.7	40.6	40.5	40.4	40.4	40.3	40.2	40.1	40.0	40.0
133	39.9	39.8	39.7	39.6	39.6	39.5	39.4	39.3	39.2	39.2
134	39.1	39.0	38.9	38.8	38.8	38.7	38.6	38.5	38.4	38.4
135	38.3	38.2	38.1	38.0	37.9	37.9	37.8	37.7	37.6	37.5
136	37.5	37.4	37.3	37.2	37.1	37.1	37.0	36.9	36.8	36.7
137	36.6	36.6	36.5	36.4	36.3	36.2	36.2	36.1	36.0	35.9
138	35.8	35.8	35.7	35.6	35.5	35.4	35.3	35.3	35.2	35.1
139	35.0	34.9	34.9	34.8	34.7	34.6	34.5	34.4	34.4	34.3
140	34.2	34.1	34.0	34.0	33.9	33.8	33.7	33.6	33.5	33.5
141	33.4	33.3	33.2	33.1	33.0	33.0	32.9	32.8	32.7	32.6
142	32.6	32.5	32.4	32.3	32.2	32.1	32.1	32.0	31.9	31.8
143	31.7	31.6	31.6	31.5	31.4	31.3	31.2	31.1	31.1	31.0
144	30.9	30.8	30.7	30.7	30.6	30.4	30.4	30.3	30.2	30.2
145	30.1	30.0	29.9	29.8	29.7	29.6	29.6	29.5	29.4	29.3
146	29.2	29.2	29.1	29.0	28.9	28.8	28.7	28.6	28.6	28.5
147	28.4	28.3	28.2	28.1	28.1	28.0	27.9	27.8	27.7	27.6
148	27.6	27.5	27.4	27.3	27.2	27.1	27.1	27.0	26.9	26.8
149	26.7	26.6	26.6	26.5	26.4	26.3	26.2	26.1	26.0	26.0
150	25.9	25.8	25.7	25.6	25.5	25.4	25.4	25.3	25.2	25.1
151	25.0	25.0	24.9	24.8	24.7	24.6	24.5	24.4	24.3	24.2
152	24.2	24.1	24.0	23.9	23.8	23.8	23.7	23.6	23.5	23.4
153	23.3	23.3	23.2	23.1	23.0	22.9	22.8	22.7	22.7	22.6
154	22.5	22.4	22.3	22.3	22.2	22.1	22.0	21.9	21.8	21.7
155	21.6	21.5	21.5	21.4	21.3	21.2	21.1	21.0	21.0	20.9
156	20.8	20.7	20.6	20.5	20.4	20.4	20.3	20.2	20.1	20.0
157	19.9	19.9	19.8	19.7	19.6	19.5	19.4	19.3	19.2	19.2
158	19.1	19.0	18.9	18.8	18.7	18.7	18.6	18.5	18.4	18.3
159	18.2	18.1	18.0	18.0	17.9	17.8	17.7	17.6	17.5	17.4
160	17.4	17.3	17.2	17.1	17.0	16.9	16.8	16.8	16.7	16.6
161	16.5	16.4	16.3	16.2	16.2	16.1	16.0	15.9	15.8	15.7
162	15.6	15.6	15.5	15.4	15.3	15.2	15.1	15.0	15.0	14.9
163	14.8	14.7	14.6	14.5	14.4	14.3	14.3	14.2	14.1	14.0
164	13.9	13.8	13.7	13.7	13.6	13.5	13.4	13.3	13.2	13.1
165	13.1	13.0	12.9	12.8	12.7	12.6	12.5	12.4	12.4	12.3
166	12.2	12.1	12.0	11.9	11.8	11.8	11.7	11.6	11.5	11.4
167	11.3	11.2	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.5
168	10.4	10.4	10.3	10.2	10.1	10.0	9.9	9.8	9.8	9.7
169	9.6	9.5	9.4	9.3	9.2	9.1	9.1	9.0	8.9	8.8
170	8.7	8.6	8.5	8.5	8.4	8.3	8.2	8.1	8.0	7.9
171	7.8	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1	7.1
172	7.0	6.9	6.8	6.7	6.6	6.5	6.5	6.4	6.3	6.2
173	6.1	6.0	5.9	5.8	5.8	5.7	5.6	5.5	5.4	5.3
174	5.2	5.1	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.5
175	4.4	4.3	4.2	4.1	4.0	3.9	3.8	3.8	3.7	3.6
176	3.5	3.4	3.3	3.2	3.1	3.1	3.0	2.9	2.8	2.7
177	2.6	2.5	2.4	2.4	2.3	2.2	2.1	2.0	1.9	1.8
178	1.7	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	1.0
179	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.2	0.1

TABLE II.—OBSERVATIONS.

No.	Date.	G. M. T.	Dist.	Table of Quan- tities.	No.	Date.	G. M. T.	Dist.	Table of Quan- tities.
	1884.	h. m.	°			1885.	h. m.	°	
1	Aug. 1	11 58	90	21.7	45	July 15	13 58	90	13.3
2	"	59	90	24.2	46	"	14 3	90	12.6
3	"	12 2	90	25.1	47	"	5	90	9.1
4	"	4	90	30.7	48	July 21	16 13	90	39.2
5	"	9	90	36.0	49	"	16	90	36.5
6	"	16	90	43.6	50	"	18	90	39.8
7	"	17	90	44.4	51	July 27	16 5	90	50.2
8	"	20	90	44.6	52	"	18	90	49.2
9	"	25	90	45.9	53	"	23	90	49.4
10	"	29	90	40.4	54	July 28	15 40	90	51.4
11	"	34	90	48.2	55	"	41	90	48.9
12	Aug. 2	9 40	90	45.6	56	"	43	90	49.9
13	"	42	90	45.3	57	"	55	15	21.1
14	"	44	75	36.6	58	"	58	30	6.8
15	"	47	60	37.4	59	"	16 1	45	10.1
16	"	50	45	9.6	60	"	4	60	22.6
17	"	52	30	6.4	61	"	9	75	42.1
18	"	54	15	0.4	62	"	11	90	50.1
19	"	56	60	15.1	63	"	14	105	40.6
20	"	10 1	90	29.6	64	"	17	120	21.6
21	"	3	90	29.2	65	"	34	105	38.8
22	Sept. 13	10 48	90	33.6	66	"	40	90	50.1
23	"	49	90	34.0	67	"	42	75	43.0
24	"	51	90	35.3	68	"	45	60	27.1
25	"	52	90	38.3	69	"	48	45	15.6
26	"	54	90	39.1	70	"	50	30	10.4
27	"	11 0	90	47.9	71	"	53	15	13.2
28	"	1	90	48.8	72	Sept. 21	16 5	90	58.8
29	"	3	90	49.5	73	"	7	90	60.7
30	"	10	90	58.2	74	"	9	90	59.1
31	"	12	90	59.3	75	"	14	15	16.6
32	"	14	90	58.8	76	"	17	30	2.3
33	"	16	90	58.3	77	"	20	45	12.6
34	Nov. 18	17 40	90	40.5	78	"	23	60	31.6
	1885.				79	"	27	75	50.8
35	June 6	14 22	90	37.9	80	"	30	90	57.0
36	"	24	90	41.4	81	"	32	105	54.8
37	"	25	90	36.5	82	"	35	120	38.8
38	June 14	10 24	90	44.2	83	"	42	105	53.2
39	"	55	90	50.7	84	"	44	90	60.5
40	"	58	90	52.6	85	"	46	75	49.0
41	"	11 0	90	52.2	86	"	48	60	29.8
42	July 1	4 32	90	45.8	87	"	51	45	11.8
43	"	35	90	45.3	88	"	53	30	1.5
44	"	36	90	45.3	89	"	55	15	16.1

The use of this polarimeter is shown in Table II., which gives some illustrations of its application to the study of atmospheric polarization. All these observations are made in the vertical plane passing through the sun. The successive columns give a number for reference, the

date, the Greenwich mean time, the angular distance of the point observed from the sun, and the resulting polarization. The first 44 sets were made by myself, the others by Miss N. A. Farrar.

Nos. 1 to 11 were made on the zenith after sunset. The later observations were difficult on account of the increasing darkness. On reducing the observations, an unexpected result was attained. The last column shows that the polarization increases regularly, becoming twice as great at the end as at the beginning of the series. The probable explanation of this phenomenon is, that after the sun has set the light reaching us from the zenith comes from the upper portions of the atmosphere. As this is presumably clearer, and more free from dust and haze, we should anticipate a more complete polarization. It affords a simple means of determining the effect of ascending to various heights above the surface of the earth. From the distance of the sun below the horizon these heights are readily calculated. Nos. 22 to 33 were made in the same way, and afford a confirmation of these results. The measures on August 1 are probably somewhat too small, owing to an inclination of the bars to the plane of polarization. On August 2, the sky was clear, but hazy around the sun. The observations were abandoned owing to the approach of cirrus clouds, which probably caused the diminution in the amount of the polarization. On September 13, the air was very clear. No satisfactory explanation appears for the small amount of polarization on July 15. The record states that clouds interfered with set 45, but that it was clear when sets 46 and 47 were taken. The bars may not have been set parallel to the plane of polarization, as it was the first time the observer had used the instrument.

The law determining the amount of polarization at different distances from the sun is indicated by the observations made on July 28 and on September 21. On the first date, the remark occurs, "Sky hazy," and on the second, "Sky entirely clear." The greater polarization on the latter date is doubtless due to this cause. Both sets show the maximum polarization at 90° . They also indicate a greater polarization at 15° than at 30° . This may be due to Babinet's neutral point; but in that case we should anticipate a negative polarization at 15° . Probably these sets are uncertain, on account of the proximity of the sun.

One of the most important applications of this polarimeter will be as a measure of the haziness of the air. As the polarization becomes insensible when the sky is entirely overcast, we apparently have a very delicate test for the amount of haze. Simultaneous observations of a

distant mountain would be particularly valuable in this connection, as a means of comparing the polarization of the sky with that of the light received from the mountain. The relative intensity of the light from the mountain and the adjacent sky should also be compared, since this quantity would also vary with the clearness of the air. All of these quantities are readily measured with this instrument. To compare the light of the sky with that received from the mountain, it is only necessary to conceal the sky line behind one of the bars, and thus compare the relative intensities of the two rays. As the vertical component of one ray will be compared with the horizontal component of the other ray, the relative intensities will be modified by the amount of the polarization. The observation should therefore be repeated, placing the sky line of the mountain behind one of the adjacent bars. The polarization of the light received from the sky and the mountain should also be determined, and we can then determine the relative intensities of the four components. These measurements will be made more readily if the polarimeter is inserted in the eyepiece of a telescope of low power, placing the bars in the focus and the double-image prism between them and the field lens. The Nicol may be placed between the field and eye lenses, or between the eye lens and the eye.